

**Remarks:**

1. Applicant respectfully requests entry of this Preliminary Amendment, which is being filed within three months of the filing date of the above-cited application.
2. Reference to **FIG. 6** was deleted from the Specification as originally filed and, as a result, paragraph [0036] was deleted from the Specification.
3. In paragraph [0048], the first three sentences were deleted and the reference to **FIG. 6** in sentence 4 was replaced with a reference to **FIG. 5**. In paragraph [0049], the definite article in the third line was replaced with the indefinite article "an". In paragraph [0051], reference to **FIG. 6** was replaced with reference to **FIG. 5**. In the subsequent paragraphs [0054] to [0057] the reference designations of the drawings were amended to match the reference designations on the amended drawings.
4. In the drawings, the angles  $\theta$  and  $\beta$  were added to **FIG. 5**. These angles are discussed in the Specification as filed in paragraphs 20 and 21 on pages 9 and 10 and in paragraphs [0049] - [0052] on pages 17 - 19. No new matter has been introduced with these amendments.

Respectfully submitted,



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Enclosed:

Marked-up copy of amendments  
Marked-up drawings  
New formal drawings

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[0038] FIG. [7] 6 shows a truncated cone hub element of a first alternative embodiment according to the present invention.

[0039] FIG. [8] 7 shows a tapered triangular tapered tube hub element of a second alternative embodiment according to the present invention.

[0040] FIG. [9] 8 shows a six-triangle struttet frame hub element of a third alternative embodiment according to the present invention.

[0041] FIG. [10] 9 shows a four-triangle struttet frame hub element of a fourth alternative embodiment according to the present invention.

[0042] FIG. [11] 10 shows a partial view of geodesic structure according to the present invention, constructed of tapered triangular tube hub elements and covered with a skin.

[0043] FIG. [12] 11 shows a plurality of struttet frame elements according to the present invention, connected to each other with an adjustable coupler.

[0044] FIG. [13] 12 shows an adjustable coupler to adjustably hold the strut ends of struttet frames in position within a structure constructed according to the present invention.

[0045] FIG. [14] 13 is an illustration of a map of the earth that was projected onto a sphere, with vertexes and triangles arranged according to the present invention and cut along edges of several triangles to create a flat map.

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## DETAILED DESCRIPTION OF THE INVENTION

[0048] [FIG. 6 shows an orthogonal view of a partial cross-section of the geodesic dome 100 constructed according to the first embodiment of the invention. Several hub elements 5<sub>A</sub>, 5<sub>B</sub>, and 5<sub>C</sub>, each with a vertex V<sub>A</sub>, V<sub>B</sub>, and V<sub>C</sub>, respectively, and an internal angle  $\beta$ , are shown arranged around a diameter of the dome 100. The overlap between adjacent hub elements 5 is the maximal overlap, whereby the outer perimeter of hub element 5<sub>A</sub>, for example, approaches the vertexes of adjacent hub elements 5<sub>B</sub>, and 5<sub>C</sub>.] Also shown in FIG. [6] 5 is an angle of structure  $\theta$ , also referred to as an external angle  $\theta$  and, when referring to this first embodiment, a dome angle  $\theta$ . For purposes of illustration, the radius R of the dome 100 is 5 m, the dome angle  $\theta$  is 10°, and the number of hub elements 5 and the strut length SL are to be calculated.

[0049] To calculate the number of hub elements 5 needed for a hemisphere, the solid angle of 360° is divided by the angular deficit  $\alpha$ . Knowing that the dome angle  $\theta$  is 10°, [the] an internal angle  $\beta$  is then equal to  $(180^\circ - \theta)/2$ , which is 85°. The angular deficit  $\alpha$  is equal to  $360^\circ (1 - \sin \beta)$ , which is 1.4°. The number of hub elements 5 required is then  $360^\circ/1.4^\circ$ , that is, 257 hub elements 5. To calculate the hub length L, shown in FIG. 5, we first calculate the strut length SL, that is, the distance between vertexes V of the hub elements 5. As can be seen in FIG. 7, the strut length SL is equal to  $\sin \theta \times R_A$ , which, in this particular embodiment, is  $(0.174)(5 \text{ m}) = 0.87 \text{ m}$ . The minimum hub length L<sub>min</sub> is SL/2 and the maximum hub length L<sub>max</sub> is slightly shorter than the strut length SL. With hub length L<sub>min</sub> and hub elements 5 that are arranged so as to just tangentially contact adjacent elements 5, the geodesic dome 100 comprising the 257 hub elements 5 described above will have a dome angle  $\theta$  of 10°, a radius R of 5 m, an angular deficit  $\alpha$  of 1.4°, and strut length SL of 0.87 m. Any amount of overlap between adjacent hub elements 5 must be added to the minimum hub length to determine the actual hub length L.

[0051] In the example described above, the dome angle  $\theta$ , which corresponds to the external angle  $\theta$ , was known to be  $10^\circ$ . The external angle  $\theta$  is the amount of deflection between one leg of the hub element 5 and an extended line from the other leg of the same hub element 5 at the vertex V. As can be seen in FIG. [6] 5,  $(2 \times \sin \beta) + \theta$  is equal to  $180^\circ$ . If the angular deficit  $\alpha$  of the hub element 5 is known, the external angle  $\theta$  of the hub element 5 and the angle of structure  $\theta$  of the structure can be calculated because, based on simple trigonometric equations, it is known that  $\sin \beta$  equals  $(1 - \alpha/180^\circ)$ . So, for example, if the angular deficit  $\alpha$  is approximately  $1.4^\circ$ , the dome angle  $\theta$  of the dome 100 is approximately  $10^\circ$ .

[0054] FIGS. [7, 8, 9, and 10,] 6, 7, 8, and 9 illustrate other types of hub elements that can be used to construct further embodiments of a geodesic structure according to the present invention. FIG. [7] 6 shows a tapered cone 11 for constructing a first alternative embodiment, FIG. [8] 7 a tapered triangle 12 for constructing a second alternative embodiment, and FIGS. [9 and 10] 8 and 9 show struttied frame elements 13 and 14, respectively, for constructing third and fourth alternative embodiments, respectively, of the geodesic structure according to the present invention. FIG. [11] 10 shows a partial view of the second alternative embodiment of a dome 200 constructed of the tapered triangular elements 12 and a skin 17. Each triangular element 12 has a wide end 12A and a narrow end 12B. The elements 12 are arranged such that each element 12 is touching adjacent elements 12, with the narrow end 12B facing in toward the center of the dome 200 forming the concave inner surface and the wide end 12A forming the outer convex surface. The first alternative embodiment according to the present invention uses the tapered cones 11, is constructed similarly to the dome 200, and is also covered with a skin.

[0055] FIG. [12] 11 shows a partial surface of the third alternative embodiment according to the present invention of a dome being constructed with the strutteted

frame elements 13. The elements 13 are hexagonal in shape and comprise three struts 13A that are crossed in the center so as to form the hexagonal shape. A tension element 15 forms the perimeter of the struttied frame element 13 and is fastened with sufficient tension to force the struts 13A into a slightly bowed or convex-concave configuration. In this third alternative embodiment, strut ends 13B protrude beyond the perimeter of the struttied frame element 13. Adaptable couplers 16 are used to couple two strut ends 13B of two adjacent struttied frame elements 13. A plurality of frame elements 13 can be connected to form a sphere having the dome angle  $\theta$  corresponding to the dome angle  $\alpha$  of the struttied frames 13. The dome constructed of such elements is then covered with a skin, similar to the dome 200 described above.

[0056] FIG. [13] 12 illustrates a very simple type of adaptable coupler 16, which is a tube, open at both ends. The strut ends 13B of two different struttied frame elements 13 can be inserted into the coupler 16. The coupler 16 is long enough to slidably hold the strut ends 13B within the coupler 16, yet allow the strut ends 13B to slidably adjust the position of the struttied frame elements 13 in place within the structure under construction. Many types of adaptable couplers 16 are available and suitable for holding the struttied frame elements 13 in a proper relationship to the other struttied frame elements 13 in the structure. Suitable couplers include clamps or tubes with holes or slots through which set screws or locking pins are insertable to hold the strut ends 13 in position.

[0057] [FIGS. 14] FIG. 13 illustrates a fifth embodiment of the invention, a map 500 of the earth. For purposes of illustration only, Oslo, Norway is the major point of interest on the map 500 and is located somewhat near the center of the map 500. The intended application of the map is to illustrate travel routes from Oslo to other points in the world. Initially, orthogonal projections of places of major interest are projected onto a sphere, each place of major interest surrounded by vertexes 18.

Attention is given not to place the vertexes **18** on areas of particular interest, but instead, to place them in areas of lesser interest, with respect to the particular focus of the map **500**. Connecting lines **19** are drawn on the sphere to connect the adjacent vertexes **18**. The resulting pattern made by the connecting lines **19** shows that the map **500** is omni-triangulated and that the triangles vary in size and are in some instances scalene triangles. The map **500** is then cut along some of the connecting lines **19** to allow the map **500** to lie flat. The map **500** has very little distortion, as the entire map is constructed of cartographic images of limited sections of the earth taken as orthogonal views.